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USE OF ANTIBIOTICS, OTHER DRUGS, AND VITAMIN B_{12} AT LOW LEVELS IN FORMULA FEEDS

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Acknowledgments

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SUMMARY

Approximately 50 percent of all of the formula feeds for poultry, hogs, dairy cattle, and beef cattle, contain antibiotics and vitamin B_{12}, according to a survey covering approximately 10 percent of the plants and 34 percent of the volume of formula feeds produced. Plants producing between 75 and 85 percent of the poultry and turkey feed included vitamin B_{12} in these feeds. Plants producing about 90 percent of the starter, grower, and broiler feeds but only 50 percent of the layer and breeder feeds included antibiotics in these types of feeds. Only a small number of plants reported using antibiotics or vitamin B_{12} in dairy feeds and most of these used them only in calf feeds. A few used antibiotics in beef cattle feeds but none used vitamin B_{12} in this type of feed. Plants producing between two-thirds and three-fourths of the swine feed reported using antibiotics and vitamin B_{12} in the feeds.

Most of the plants now using antibiotics, vitamin B_{12}, arsonic compounds, or surfactants, began using them during the period 1949-53. Few have begun such usage since 1953. Undoubtedly the proportion of the total volume of feeds containing these items has been increasing steadily.

Most large volume plants purchased these ingredients on a carrier or in a partial premix. Most small plants purchased them in a complete or nearly complete mixing supplement.

Penicillin was used by most plants and in most feeds for the smaller and younger animals. Broad spectrum antibiotics were used by most plants and in most feeds for the older and larger animals.

The average levels of antibiotic content in grams of penicillin were about 3.5 grams in broiler feed, 3.2 grams in starter feed, and about 2.7 grams per ton in grower, and layer and breeder feeds. Pig feeds contained an average of about 16.5 grams of broad spectrum antibiotics per ton and hog feeds about 12.5 grams per ton. An average of about 27 grams of broad spectrum antibiotics were included in the calf feeds. All of these averages are based on the antibiotic content of the largest selling feeds of each type and cover only plants in which these feeds contain antibiotics.

Vitamin B_{12} content levels shown are merely averages of amounts of vitamin B_{12} added as such. They do not include the vitamin B_{12} content present in the feed in fish meal, liver meal, etc. Some feeds contain a sufficient amount of vitamin B_{12} from these sources, others require supplementation, and to still others all of the required amount must be added as a separate ingredient.

USE OF ANTIBIOTICS, OTHER DRUGS, AND VITAMIN B_{12} AT LOW LEVELS IN FORMULA FEEDS

By V. John Brensike, agricultural economist
Agricultural Marketing Service

More than 50 percent of the total formula feeds produced for poultry, hogs, dairy cattle, and beef cattle during the year July 1, 1954 to June 30, 1955, contained low levels of antibiotics for growth promotion and stimulation. This average, however, covers up a considerable variation between types of feed. For example, low levels of antibiotics are included in poultry and turkey starter, grower, and broiler feeds by plants producing about 90 percent of the volume of each type of feed. Plants producing nearly 50 percent of the total layer and breeder feeds included antibiotics in these feeds. Low levels of antibiotics are also included by plants producing almost three-fourths of the total pig and hog feeds, but only about 5 percent of the dairy and beef feeds.

Similarly about 50 percent of the total poultry, hog, dairy, and beef cattle feeds produced during the same fiscal year contained vitamin B_{12}. This average again covers up a considerable variation by types of feed. For example, vitamin B_{12} is included in each type of poultry and turkey feed by plants producing from 75 to 85 percent of the volume. It was not included in any beef cattle feeds produced in the sample plants and in only 5 percent of the plants producing dairy cattle feeds, almost all of which was for calves. Plants producing about two-thirds of the volume of swine feeds added vitamin B_{12} to these types of feeds.

These estimates are based on a survey covering a little more than 10 percent of the plants manufacturing a little over 30 percent of the total volume shown by estimates based on census reports.

For 1954, the U. S. Tariff Commission reported sales of 255,148,000 grams of antibiotics to be used in animal feed supplements.1/ Of this total, approximately 60 percent appears to have been for use in low level antibiotic feed for poultry, hog, dairy, and beef cattle, for growth promotion. The remaining 40 percent would therefore have been used in (1) therapeutic or high level antibiotic feeds, for treatment of various flock and herd conditions or diseases, (2) dog and cat food, (3) rabbit, fox, mink, and laboratory animal feeds, (4) horse and mule feeds and (5) miscellaneous bird and animal feeds. We do not mean to imply that antibiotics are used in all of the above mentioned types of feed but merely enumerate the classes of feed likely to be represented.

1/ Preliminary Synthetic Organic Chemicals, United States Production and Sales of Medicinals, 1954, U. S. Tariff Commission, August 1955, p. 2.

Background

Antibiotics, vitamin B_{12}, arsonic compounds, surfactants, and hormones all have been introduced into animal feeds since 1948. Use of these drugs and vitamins in formula feeds gained wide acceptance rapidly because of their efficiency in producing rapid gains and high production with reduced feed intake, and the therapeutic value of the drugs.

Prior to 1948, vitamin B_{12} was present in formula feeds only because the protein supplements of animal origin in the feeds contained it. Liver meal, fish meal, fish solubles, and some packing house byproducts are among the animal products containing relatively large amounts of this vitamin. The amounts of this vitamin contained are, however, variable and cannot be relied upon to furnish the desired nutritional levels. Since early research had indicated that animals gained and produced more rapidly on feeds containing animal proteins, many firms made special efforts to include them in their feeds.

Before vitamin B_{12} was isolated, it was not known what factor in animal proteins caused this more rapid growth but it was termed A.P.F. (animal protein factor). With the isolation of vitamin B_{12} in 1948 it was immediately apparent that this new vitamin was at least partly responsible. Not only did the pure vitamin B_{12} increase gains and production but further research indicated that the fermentation products, from which the vitamin was obtained, increased production even more when added to formula feeds. The reason for this is now clearly attributable to the fact that they contained some antibiotic residues. These fermentation products are byproducts of the manufacture of antibiotics and contain antibiotics residues.

Antibiotics, arsonic compounds, surfactants, and hormones are all considered drugs and their use is controlled by the Food and Drug Administration. Despite their proven growth-promoting qualities, these items cannot be classed as nutrients.

Antibiotics, especially, are extremely useful in the treatment of human and animal diseases. They are extensively used in pure form for treating individual animals, and also flocks and herds. They are also widely used in therapeutic feeds at levels high enough to treat flocks and herds for certain diseases. In this study, however, we are primarily concerned with the use of low levels of antibiotics in regular formula feeds to promote growth in livestock and poultry. The use of vitamin B_{12}, arsonic compounds, surfactants, and hormones in formula feeds were also analyzed in this study at levels recommended for increasing production.

Objectives

The objectives of this study were to analyze the use of certain drugs and vitamins, at growth-promoting levels, in formula feeds. We sought to answer such questions as:

(1) How rapidly did large numbers of feed mills include these items in their feeds? Did adaption vary by plant volume or geographic location?

(2) Is the antibiotic and vitamin B_{12} market potential greater in one type of formula feed than another? If so, why?

(3) In what form do the formula feed plants tend to buy and use these drugs and vitamins? Does the form vary by size of plant or with geographic area?

(4) What type of antibiotic do feed manufacturers tend to use? Does it vary by type of feed, plant volume, or geographic area?

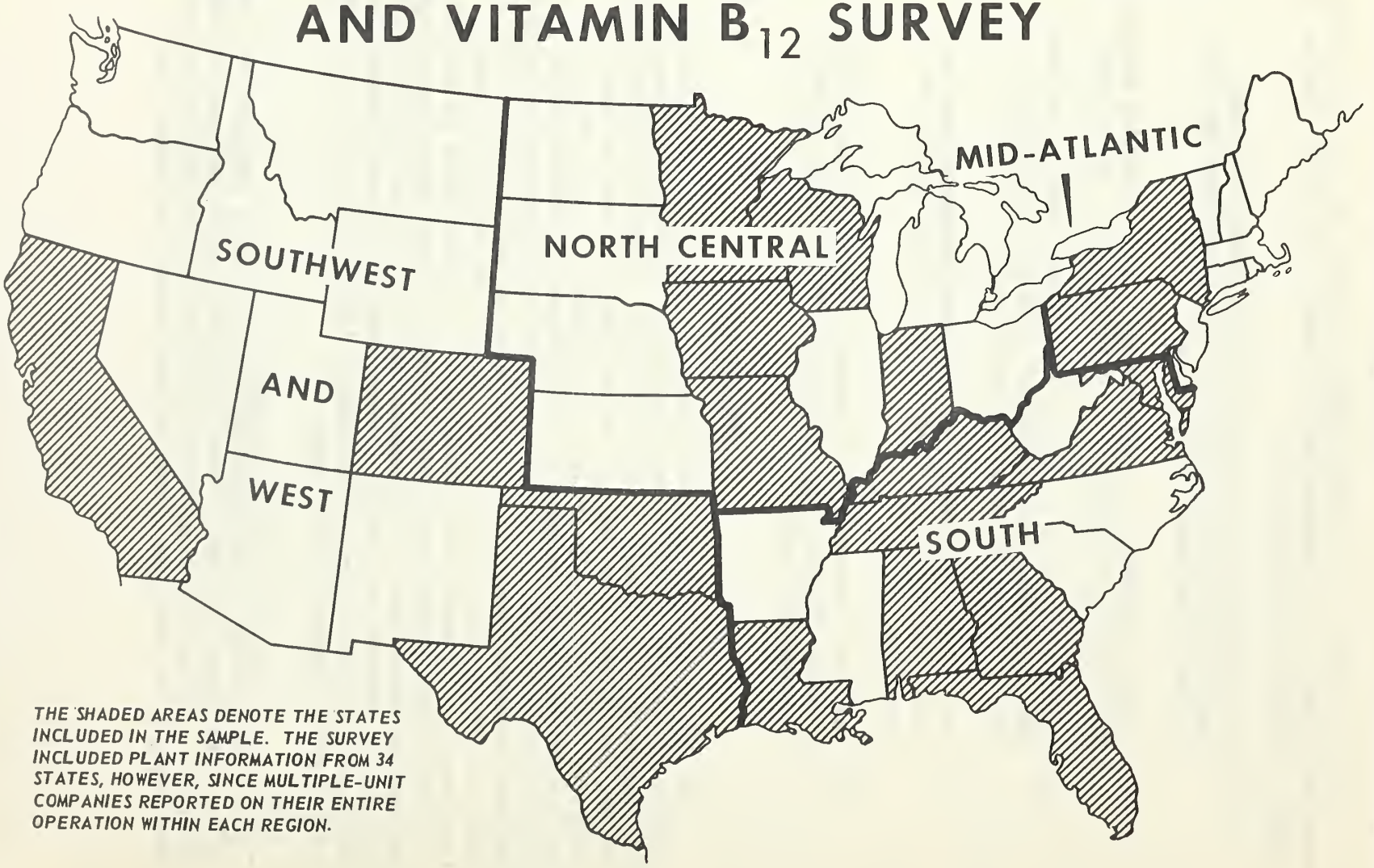
(5) What are the average and range of variations in levels of use? Do they vary by types of feed, plant volume, or geographic area?

Methodology

The use of antibiotics and vitamin B_{12} in the formula feed industry was studied as part of another study designed to analyze the use of molasses in the formula feeds industry.2/ Although neither the geographic breakdown of the United States (figure 1) nor the sampling technique followed in each region was designed for this study, the regions and the random selection of sample and alternate plants in each region were acceptable. The universe sampled in the various regions differed somewhat since an effort was made to include more of the larger plants in the Southwest and Western region, especially California. For this reason no attempt should be made to compare regions on the basis of size of plant, number of plants, volume of feed mixed, percentage of feed custom mixed, etc. It appears, however, that interregional comparisons of methods and levels of drugs used can be made because the volume covered was a large proportion of the industry total and plant selection was random in each area.

2/ Three reports on marketing molasses are being prepared for publication: The first, relates to the direct feed use of molasses on the farm; the second, to the influence of transportation facilities; and the third, to an analysis of the molasses market in formula feeds.

AREAS INCLUDED IN THE ANTIBIOTIC AND VITAMIN B_{12} SURVEY



THE SHADED AREAS DENOTE THE STATES INCLUDED IN THE SAMPLE. THE SURVEY INCLUDED PLANT INFORMATION FROM 34 STATES, HOWEVER, SINCE MULTIPLE-UNIT COMPANIES REPORTED ON THEIR ENTIRE OPERATION WITHIN EACH REGION.

U. S. DEPARTMENT OF AGRICULTURE

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An estimated 327 plants, or over 10 percent of the industry as defined by the census, were included in the survey. The actual feed tonnage produced by the plants in the survey represents about 34 percent of the industry production. The number of plants, their volumes and other material showing the type of plants included in the study in each region, and volume are are shown in table 1. These regions and volume groupings will be used in the remainder of the report.

The schedules were completed by personal interview during the last 4 months of 1954 and the first 4 months of 1955. Eastern and Southern regions were visited early in the survey, Central and Western regions later.

Dynamic Nature of This Field

It is important that the time of interview be kept in mind because of the rapidity with which plants and companies have initiated use of these materials and the fact that research is continually introducing new drugs. For example, hormones were merely in the research stage and being considered for use when the study began. Stilbestrol was cleared by the Food and Drug Administration for use in beef cattle feeds in December 1954 and in interviews following this date was often mentioned as being used, even though it was not included in the schedule. Its introduction and use also appear to have influenced the use of antibiotics since some plants not previously using antibiotics in beef cattle feed began using or planned to use certain antibiotics along with stilbestrol.

Percentage of plants using antibiotics by types of feed.- At the time of the survey, late 1954 and early 1955, about 93 percent of the plants producing poultry feed used antibiotics, 60 percent used them in hog feed, 22 percent in dairy feed, and 4 percent in beef cattle feed.

A larger proportion of the large plants used antibiotics in each type of feed regardless of the geographic area in which the plant is located (table 2). From this we assume that the volume of feed in which antibiotics are mixed is somewhat larger than shown above or in table 2. The larger plants manufacture much more feed than their numerical proportion indicates. It should be pointed out, however, that these plants do not necessarily use them in all types of feed. For example, they may use them in feed for pigs and not for hogs, or in starter feed and not in grower, broiler, and layer and breeder feed. (See pp. 14-18 for separate discussion of each of these types of feed.)

The geographical location of the plants does not appear to have an important influence on the proportion of plants using antibiotics with few exceptions. Where dairying is most important there is a tendency for a greater percentage of plants to use antibiotics, and the reverse situation shows up for small plants in the hog production areas (table 2).

Table 1.- Number of plants, tons of feed mixed per year, and type of mixing operation performed, by region.

Regions and tons produced per year	Number of plants	Tons of feed mixed per year	Percentage of -			Percentage of plants not mixing -			
			Production custom mixed	Sales merely retailed	Plants mixing custom feed only	Poultry feed	Swine feed	Dairy cattle feed	Beef cattle feed
	Number	Tons	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Mid-Atlantic									
Under 15,000	45	90,800	49	33	7	9	22	9	40
15,000 and over	1/16	964,596	1	0	0	0	6	0	25
South									
Under 15,000	54	187,896	34	14	13	7	17	7	15
15,000 and over	2/25	1,364,377	1	0	0	0	0	8	8
North Central									
Under 15,000	62	148,548	54	25	35	3	8	7	0
15,000 and over	3/62	4,538,883	1	0	0	0	0	0	0
Southwest and West									
Under 15,000	32	86,490	29	28	10	34	28	28	28
15,000 and over	4/31	2,013,462	1	0	0	3	19	10	13

1/ Includes an estimated number of plants to cover the operations of 3 large chain companies in the region.

2/ Includes an estimated number of plants to cover the operations of 5 large chain companies in the region.

3/ Includes an estimated number of plants to cover the operations of 10 large chain companies in the region.

4/ Includes an estimated number of plants to cover the operations of 7 large chain companies in the region.

Table 2.- Number of plants mixing each type of feed, percentage of plants using antibiotics, and reasons given for not using antibiotics

Region and tons produced per year	Poultry feed				Swine feed				Dairy cattle feed				Beef cattle feed			
	Plants mixing	Percentage of plants			Plants mixing	Percentage of plants			Plants mixing	Percentage of plants			Plants mixing	Percentage of plants		
		Using antibiotics	Not using antibiotics			Using antibiotics	Not using antibiotics			Using antibiotics	Not using antibiotics			Using antibiotics	Not using antibiotics	
			No reason given	Not necessary			No reason given	Not necessary			No reason given	Not necessary			No reason given	Not necessary
	Number	Percent	Percent	Percent	Number	Percent	Percent	Percent	Number	Percent	Percent	Percent	Number	Percent	Percent	Percent
Mid-Atlantic																
Under 15,000	41	92	8	0	35	72	13	15	41	13	10	77	27	4	13	83
15,000 & over	16	100	0	0	15	94	6	0	16	25	0	75	12	0	0	100
South																
Under 15,000	50	86	11	3	45	69	7	24	50	11	24	65	46	0	36	64
15,000 & over	25	96	4	0	25	100	0	0	23	35	22	43	23	4	22	74
North Central																
Under 15,000	60	89	6	5	57	28	32	40	58	19	33	48	62	0	46	54
15,000 & over	62	100	0	0	62	100	0	0	62	53	11	36	62	11	21	68
Southwest and West																
Under 15,000	21	95	5	0	23	66	17	17	23	15	10	75	23	15	10	75
15,000 & over	30	100	0	0	20	100	0	0	28	64	7	29	27	0	18	82

Poultry feed.- The practice of adding antibiotics and vitamin B_{12} to poultry feeds was adopted by about 93 percent of all plants in the short span of only 5 years. Arsonic compounds were also adopted rapidly by the large plants and are now used by nearly all large plants but by only a small proportion of the small plants (table 3). The introduction of arsonic compounds in formula feeds, however, started about a year or two later than antibiotics and vitamin B_{12}. Few plants either large or small use surfactants in poultry feeds (table 3).

Both antibiotics and vitamin B_{12} were used in nearly all plants, although a few plants used one and not the other. It is interesting to note that vitamin B_{12} was adopted in a larger proportion of the plants than antibiotics in the earlier years but within 2 years the picture had been reversed and antibiotics were being used in poultry feed in a slightly larger proportion of the plants than was vitamin B_{12}. However, fish meal, liver meal, and other packing house byproducts also contain vitamin B_{12}. Thus, some formula feeds may contain a sufficiently high level of vitamin B_{12}, others may require slight vitamin B_{12} supplementation, and others require a complete supplementation of vitamin B_{12}. The entire vitamin B_{12} content of a feed is not considered here, but only that obtained from including vitamin B_{12} as such in formula feeds.

Pig and hog feed.- Approximately 60 percent of the plants mixing hog feed included antibiotics in the formula feeds and 53 percent included vitamin B_{12}. It took about 6 years for all of these plants to include these ingredients in formula hog feeds (table 4). Most of these plants now use these antibiotics in both pig and hog feed.

Reports that antibiotics were "not necessary" were given as the reason for not adding antibiotics to pig and hog feed by from 15 percent of the small plants in the Mid-Atlantic area to 40 percent of the small plants in the North Central States. None of the large plants operating in any area reported the opinion that antibiotics were "not necessary" in this type of feed (table 2).

Calf and other dairy feed.- Approximately 22 percent of the plants mixing cattle feed include antibiotics and about 17 percent vitamin B_{12} in their formula feed. Most of these plants, especially the large plants, use it in calf feeds but not in feed for mature dairy stock. Some of the plants began adding these ingredients before 1950 and all of them except a few in the North Central region had begun adding them before 1953 (table 5).

Table 3.- Poultry feed: Number of plants using antibiotics or vitamin B_{12} and the percentage of plants starting use of antibiotics and vitamin B_{12} and other drugs by time periods

Region and tons produced per year	Plants using antibiotics or vitamin B_{12}	Percentage of plants starting use of -															
		Antibiotics				Vitamin B_{12}				Arsonic compounds				Surfactants			
		Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955	Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955	Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955	Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955
	Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Mid-Atlantic																	
Under 15,000	35	31	46	20	3	31	46	20	3	3	--	3	--	--	--	3	--
15,000 & over	16	--	100	--	--	38	62	--	--	--	19	81	--	--	--	--	--
South																	
Under 15,000	37	19	62	14	3	19	64	14	3	3	14	3	--	--	--	--	--
15,000 & over	24	25	71	4	--	38	38	17	--	4	25	54	--	--	--	--	8
North Central																	
Under 15,000	34	20	56	24	--	20	53	24	--	--	--	9	--	--	--	--	3
15,000 & over	62	21	76	3	--	42	35	10	--	--	27	55	10	--	--	--	--
Southwest and West																	
Under 15,000	17	24	52	18	6	24	41	12	6	12	--	12	6	--	--	--	--
15,000 & over	30	40	57	3	--	57	37	3	--	3	23	13	3	--	3	--	--

Table 4.- Pig and hog feed: Number of plants using antibiotics or vitamin B_{12} and the percentage of plants starting use of antibiotics and vitamin B_{12} by time periods

Region and tons produced per year	Plants using antibiotics or vitamin B_{12}	Plants starting use of - Antibiotics: Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955	Vitamin B_{12}: Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955
	Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Mid-Atlantic									
Under 15,000	23	39	48	13	--	35	30	13	--
15,000 and over	14	--	100	--	--	--	50	--	--
South									
Under 15,000	26	19	65	16	--	19	58	16	--
15,000 and over	25	16	76	8	--	44	32	24	--
North Central									
Under 15,000	11	18	64	9	--	27	64	9	--
15,000 and over	62	23	76	1	--	42	39	11	--
Southwest and West									
Under 15,000	11	18	55	18	9	18	36	9	9
15,000 and over	25	20	80	--	--	36	52	--	--

Table 5.- Calf and other dairy cattle feed: Number of plants using antibiotics or vitamin B_{12}, and the percentage of plants starting use of antibiotics, vitamin B_{12}, by time periods

Region and tons produced per year	Plants using antibiotics or vitamin B_{12}	Plants starting use of - Antibiotics: Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955	Vitamin B_{12}: Prior to 1950	1950 or 1951	1952 or 1953	1954 or 1955
	Number	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Mid-Atlantic									
Under 15,000	5	60	20	20	--	40	--	20	--
15,000 and over	4	--	25	75	--	--	--	75	--
South									
Under 15,000	6	--	50	33	--	--	67	33	--
15,000 and over	8	12	13	75	--	--	--	75	--
North Central									
Under 15,000	7	14	71	15	--	29	57	14	--
15,000 and over	33	4	39	39	18	21	21	24	18
Southwest and West									
Under 15,000	3	33	67	--	--	--	33	--	--
15,000 and over	18	--	28	72	--	17	11	17	--

Most of the plants not using antibiotics in dairy feed reported that antibiotics were unnecessary in this type of feed. A high of about 75 percent of the small plants in both the Mid-Atlantic and the Southwest and Western regions and a low of 48 percent in the North Central region reported it was unnecessary (table 2). In general, fewer large plants reported antibiotics as "not necessary" in this type of feed.

Beef cattle feed.- At the time of the survey few plants (4 percent) used antibiotics and less than 1 percent used vitamin B_{12} in their beef cattle feeds. The introduction of stilbestrol in beef cattle feeds apparently has caused a new interest in the use of certain antibiotics in beef cattle feeds in combination with stilbestrol. No new plants added antibiotics to beef cattle feed during 1953 or 1954, but later visits disclosed that some plants did plan to add antibiotics and stilbestrol during 1955.

At the time of the survey most plants, large or small and regardless of geographic location, felt that antibiotics were unnecessary in beef cattle and range feeds.

Miscellaneous animal feeds.- Although this survey did not cover the use of antibiotics in feeds for animals other than livestock or poultry, many companies voluntarily supplied information indicating that they included antibiotics in dog and cat feeds, and in rabbit feeds. Many companies also reported that they included antibiotics in many of their therapeutic feeds. The information given here is not necessarily complete since it is based on unsolicited comments.

How Drugs are Purchased and Used by the Feed Industry

Antibiotic and vitamin B_{12} producers supply the formula feed industry with these ingredients in pure form, on a carrier (one or both ingredients) or in a partial premix (these ingredients plus other vitamins, minerals, salt and minor elements), and in a complete mixing concentrate (all ingredients except grain). Most of the producers of antibiotics and vitamin B_{12} sold these ingredients to the formula feed industry on carriers or in partial premixes. Both of these partial mixes are included at a rate of from 1 to 20 pounds per ton of finished feed. Often these ingredients are mixed by the first feed mill into finished feed, that is, feed ready for sale to the feeder. However, in many other cases these ingredients are mixed by feed mills into complete mixing concentrates for sale or transfer to other retail feed dealers for mixing with grain prior to final sale. Many of the plants performing these or similar operations have better equipment for mixing small quantities and better quality control than could be obtained with complete mixing in small decentralized plants. Many small plants like this service, especially for sideline feeds for which there is not sufficient demand to permit the carrying of completely mixed feed stocks.

In purchasing and mixing these items in their feeds the feed mill contacted in this survey indicated they followed the practices shown in table 6. It should be pointed out, however, that definitions of complete mixing concentrates, mixing supplements, etc., vary and that there is no clear line of demarcation between them and partial premixes.

Most large plants purchase these ingredients on a carrier or in a partial premix. Most small mills purchase and use these ingredients in a complete or relatively complete mixing concentrate (including all items except grain or grain and protein). Few plants, except the large ones (primarily chain) located in the North Central, and Southwest and Western regions, obtain the antibiotics or vitamin B_{12} as separate ingredients.

Table 6.- Percentage distribution of plants by form of drug or vitamin when purchased and used by feed manufacturers, by region and by size of plant

Region and tons produced per year	Separate ingredient	In a partial premix	Complete mixing concentrate or supplement	Total
	Percent	Percent	Percent	Percent
Mid-Atlantic				
Under 15,000	3	36	61	100
15,000 and over	0	100	0	100
South				
Under 15,000	5	30	65	100
15,000 and over	12	76	12	100
North Central				
Under 15,000	6	21	73	100
15,000 and over	1/ 24	1/ 90	1/ 15	100
Southwest and West				
Under 15,000	14	36	50	100
15,000 and over	24	62	14	100

1/ Percentages add to more than 100 percent since one chain and one individual plant used more than one method, depending on type of feed.

Type of Feed and Type of Antibiotic Used

In reviewing the picture of the type of feed produced and the type of antibiotic used, it is necessary to remember that the various types of antibiotics were discovered at different times and their use or application in formula feeds came about at different times. Therefore, the type of antibiotic used in the various feeds at the time of our visit (late 1954 and early 1955) may, but need not necessarily, reflect the actual relative feeding values of these various types of antibiotics in the specific type of feed. Various combinations of two or more types were reported as used and according to research results, frequently yield as good or better growth, production, and net income results.

About 60 percent of the plants using antibiotics in starter, grower, and broiler feeds used penicillin. The older or larger the animal for which the feed was being produced the smaller the percentage of plants using penicillin (table 7). The other important antibiotics for feed use, chlortetracycline (Aureomycin) and oxytetracycline (Terramycin), were used by far more plants in preparing feeds for larger and older animals but by a smaller percentage of the plants mixing poultry feeds (table 7). Bacitracin accounts for most of the other antibiotics used in formula feeds. Many of the newer antibiotics have not yet entered the feed field.

Table 7.- Total number of plants using antibiotics in each type of feed, and the percentage of plants using various types of antibiotics

Type of feed	Plants using antibiotics 1/	Percentage of plants using		
		Penicillin	Broad spectrum antibiotics 2/	Other 3/
	Number	Percent	Percent	Percent
Starter	218	62	35	3
Grower	226	59	38	3
Broiler	217	62	37	1
Layer and breeder	149	50	47	3
Pig	189	14	85	1
Hog	157	11	88	1
Calf	93	0	99	1

1/ Contains some duplication because a few plants used these antibiotics in combination.

2/ Aureomycin and Terramycin. 3/ Primarily bacitracin.

Antibiotic Content of Formula Feed

In reviewing the antibiotic content of the various types of feeds, tables 8 and 9, it should be remembered that:

1. All antibiotic and vitamin B_{12} contents or amounts are average levels for complete finished feeds. No effort was made to obtain the amount of antibiotics or vitamin B_{12} added to the feeding or mixing concentrates produced.

2. The regional breakdown is not shown to emphasize any significant differences between regions. Summarization in this form was necessary because the sample was drawn on a regional basis which made it difficult to weight into a national summary. Some regional differences, however, do appear to be valid and informative.

3. The volume groupings of under 15,000 tons, and 15,000 tons and over per year, are not shown to emphasize any significant differences between them. However, some major differences do appear to be significant in spite of the small number of plants reporting in each volume grouping. The primary reason for the separate listings is that the plants included in the small volume group were obtained from the random sample selection and most of the plants in the larger volume group were operated by large chain organizations, all of whom were contacted.

It appears that the average contents or amounts shown for the large volume group are relatively more representative than the average amounts shown for the smaller volume plants. This is true because, (1) the range in the individual plant operations is less than in the small plants, and (2) the sample plant volumes represent a larger proportion of the universe than is true in the case of the small plants.

Poultry feed.- It is estimated that an average of approximately 3.5 grams of antibiotics was included in each ton of broiler feed, 3.2 grams per ton of starter feed and about 2.7 grams in each ton of grower, and layer and breeder feeds. These estimates are based on an approximate weighted average of the data shown in table 8, after the "other" antibiotics had been converted to a penicillin equivalent by dividing by 3. This 3-to-1 ratio merely recognizes that all antibiotics are not equal and converts them to somewhat similar units on the basis of the average levels of use.

There appears to be some indication that when small plants use antibiotics in a given type of poultry feed they tend to put a slightly larger amount in each ton than do the larger plants. Table 2

Table 8.- Poultry feed: Average antibiotics content and range per ton, by plant volume and region

Region and plant volume in tons per year	Plants reporting use 1/	Plants reporting level of use	Grams per ton: Simple average: Penicillin	Grams per ton: Simple average: Other 2/	Grams per ton: Range: Low 3/	Grams per ton: Range: High 4/	Plants reporting level of use	Grams per ton: Simple average: Penicillin	Grams per ton: Simple average: Other 2/	Grams per ton: Range: Low 3/	Grams per ton: Range: High 4/
	No.	No.	Gm.	Gm.	Gm.	Gm.	No.	Gm.	Gm.	Gm.	Gm.
			Starter					Grower			
Mid-Atlantic											
Under 15,000	35	14	2.5	6.5	0.4	10.0	13	2.0	5.7	0.4	10.0
15,000 & over	16	16	2.4	7.4	1.0	8.1	14	1.5	3.0	0.5	3.3
South											
Under 15,000	37	14	3.1	6.6	2.0	9.0	13	3.0	6.2	0.4	9.0
15,000 & over	24	22	2.9	6.0	1.0	10.0	22	2.2	3.5	0.5	10.0
North Central											
Under 15,000	34	14	3.4	9.9	1.0	25.0	17	3.3	11.9	1.0	25.0
15,000 & over	62	61	3.8	6.6	2.0	8.1	61	2.7	2.9	0.5	6.0
Southwest & West											
Under 15,000	17	8	3.5	8.1	3.0	9.0	7	3.5	8.1	3.0	9.0
15,000 & over	31	26	4.0	4.9	2.0	10.0	23	3.2	4.1	0.5	9.0
			Broiler					Layer and breeder			
Mid-Atlantic											
Under 15,000	35	10	3.1	7.6	0.6	10.0	10	2.1	6.6	0.8	10.0
15,000 & over	16	15	2.8	9.9	1.5	10.8	7	2.1	6.0	1.0	6.5
South											
Under 15,000	37	14	3.4	7.7	2.0	9.0	11	3.0	5.2	0.4	9.0
15,000 & over	24	22	3.1	7.0	2.0	10.8	8	2.9	5.9	2.0	6.5
North Central											
Under 15,000	34	12	4.0	9.2	1.0	25.0	20	2.9	11.5	1.0	25.0
15,000 & over	62	59	3.7	7.9	2.0	10.8	14	2.7	6.3	1.0	6.5
Southwest & West											
Under 15,000	17	6	3.5	7.2	3.0	7.2	6	3.5	7.2	3.0	7.2
15,000 & over	31	25	4.5	4.0	2.0	10.0	7	5.2	5.0	2.0	9.0

1/ In any poultry feed.

2/ Primarily broad spectrum antibiotics.

3/ Penicillin in nearly all cases.

4/ Broad spectrum antibiotics in nearly all cases.

indicates that nearly all large plants include antibiotics in poultry feeds while many small plants leave them out.

The regional picture, on the other hand, seems to indicate a tendency for the North Central, and the Southwest and West area plants to use a slightly higher level of antibiotics in most types of poultry feed than do plants located in the Mid-Atlantic and the Southern areas. The largest number of plants reporting the use of antibiotics in the best selling feed of each type and the content in the feed also indicate the importance of the specific type of poultry industry in each area.

Hog, dairy, and beef feeds.- In discussing these feeds it is necessary to use a national average because of the smaller number of plants reporting the use of antibiotics in their largest selling feed. Even with this consolidation too few plants reported levels of use in dairy feed, other than calf, to permit summarization and none reported a level of use in beef cattle feeds.

Table 9 indicates the total number of plants using antibiotics, the total number giving levels of use, and the average and range of use reported for pig, hog, and calf feeds. The antibiotic content, in broad spectrum antibiotic equivalent, average about 16.5 grams per ton of pig feed, 12.5 grams per ton of hog feed, and about 27 grams per ton of calf feed. Penicillin contents were converted to this base by multiplying by 3. As indicated in the discussion of poultry feed, this 3-to-1 ratio merely recognizes that all antibiotics are not equal and converts them to somewhat similar units on the basis of average levels of use.

Vitamin B_{12} Content

Poultry feeds.- The amount of vitamin B_{12} in starter, grower, broiler, and layer and breeder feeds varied considerably between regions, between plants of different volume, and between similar plants (table 11). Much of this variation in the amounts of vitamin B_{12} is not due to basic differences in policy concerning the use of vitamin B_{12} in feeds but is primarily attributable to the fact that these averages, unlike the antibiotics averages, cover up differences in needs. For example, (1) many plants reported not using any vitamin B_{12} because a sufficient quantity was included in the feed from fish meal, liver meal, and other packing house products. (2) Many plants reported low levels of use because they merely supplemented the vitamin B_{12} obtained from the above mentioned ingredients. (3) Many plants put in high levels of vitamin B_{12} as their feed did not contain vitamin B_{12} from other sources.

Hog, dairy, and beef feeds.- Table 10 summarizes comparable vitamin B_{12} levels of use in pig, hog, and calf feeds. As was true in the antibiotic study too few plants reported levels of use in dairy feed, other than calf, to permit analysis. Since vitamin B_{12} can be obtained from fish and animal sources and these ingredients are frequently used in pig and hog feeds, much of the variation in milligrams added per ton can again be attributed to this fact.

Table 9.- Pig, hog, and calf feeds: Average antibiotic content and range per ton, by plant volume

Type of feed and total plant volume in tons per year	Plants reporting levels of use	Grams per ton			
		Simple average		Range	
		Penicillin	Other 1/	Low	High
	Number	Grams	Grams	Grams	Grams
Pig feed					
Mixed in plants					
Under 15,000	32	9.9	18.5	0.6	50.0
15,000 and over	116	3.5	15.3	1.5	50.0
Hog feed					
Mixed in plants					
Under 15,000	38	10.5	16.4	0.6	50.0
15,000 and over	91	3.0	11.5	1.0	50.0
Calf feed					
Mixed in plants					
Under 15,000	9	2/	6.2	1.2	36.0
15,000 and over	33	2/	25.1	6.0	50.0

1/ Primarily broad spectrum antibiotics.
2/ Only 1 plant reporting.

Table 10.- Pig, hog, and calf feeds: Average vitamin B_{12} content and range per ton, by plant volume

Type of feed and total plant volume in tons per year	Plants reporting levels of use	Milligrams per ton		
		Simple average	Range	
			Low	High
	Number	Mg.	Mg.	Mg.
Pig feed				
Mixed in plants				
Under 15,000	16	9.2	1.2	20.0
15,000 and over	98	9.1	2.3	15.0
Hog feed				
Mixed in plants				
Under 15,000	22	11.8	1.2	20.0
15,000 and over	87	5.6	1.5	20.0
Calf feed				
Mixed in plants				
Under 15,000	4	5.6	3.6	8.0
15,000 and over	43	9.2	3.0	15.0

Table 11.- Poultry feed: Average vitamin B_{12} content and range per ton, by plant volume and region

Region and plant volume in tons per year	Plants reporting level of use	Milligrams per ton: Simple average	Range: Low	Range: High	Plants reporting level of use	Milligrams per ton: Simple average	Range: Low	Range: High
	No.	Mg.	Mg.	Mg.	No.	Mg.	Mg.	Mg.
	Starter				Grower			
Mid-Atlantic								
Under 15,000	9	3.8	1.2	6.0	6	3.2	1.2	6.0
15,000 and over	12	4.3	0.3	12.0	11	2.2	0.1	7.5
South								
Under 15,000	12	6.5	1.8	14.4	12	6.7	0.4	14.4
15,000 and over	18	5.2	0.3	12.0	18	7.2	0.1	12.0
North Central								
Under 15,000	10	8.6	2.1	15.0	11	7.9	2.0	15.0
15,000 and over	54	7.3	0.3	12.0	54	5.2	0.1	12.0
Southwest and West								
Under 15,000	5	7.2	4.5	15.0	5	7.2	4.3	15.0
15,000 and over	18	9.2	0.3	12.0	18	5.6	0.1	12.0
	Broiler				Layer and breeder			
Mid-Atlantic								
Under 15,000	7	3.8	2.0	6.0	7	6.1	2.4	18.0
15,000 and over	12	4.9	0.3	12.0	12	3.9	2.0	7.5
South								
Under 15,000	12	7.3	3.0	14.4	9	6.2	0.4	14.4
15,000 and over	19	6.2	0.3	12.0	14	4.2	2.0	6.0
North Central								
Under 15,000	6	7.7	2.1	15.0	15	7.9	2.0	20.0
15,000 and over	54	7.3	0.3	12.0	42	4.5	2.0	18.0
Southwest and West								
Under 15,000	4	5.2	4.5	7.5	4	5.2	4.5	7.5
15,000 and over	18	10.1	0.3	15.0	15	7.3	2.0	15.0